

## THREE ECHINODERM INHABITING FLATWORMS (PLATYHELMINTHES, RHABDOCOELA) FROM WESTERN AUSTRALIA

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**Summary.** Three new species of flatworms symbiotic in echinoderms from Western Australia are described. *Pterastericola rotnestensis* n.sp. belongs to the Pterastericolidae. *Syndesmis cannoni* n. sp. and *Wahlia westbladi* n. sp. are members of the Umagillidae.

*Key words:* *Ammotrophus*, *Astropecten*, Echinodermata, Platyhelminthes, *Pterastericola*, Pterastericolidae, Rhabdocoela, *Stichopus*, symbionts, *Syndesmis*, Umagillidae, *Wahlia*, Western Australia

### INTRODUCTION

The rhabdocoel flatworms of the Pterastericolidae and Umagillidae are endosymbionts of echinoderms. Eastern Australian representatives of the two groups were treated by CANNON in numerous papers (1974, 1978, 1982, 1986, 1987 and 1990). To-date there are no Australian records of the groups outside Queensland and New South Wales.

The present paper reports the first new species of the Umagillidae and Pterastericolidae (Platyhelminthes, Rhabdocoela) occurring on the Australian west coast.

### MATERIAL AND METHODS

Specimens of host echinoderms were collected by SCUBA diving (*Astropecten preisi* Müller and Troschel, 1843, *Stichopus mollis*, (Hutton, 1872)) or dredging (*Ammotrophus arachnoides* H.L. Clark, 1938) off Rottnest Island, Western Australia in January 1991. The echinoderms were dissected, the intestine and the rest of the body placed in separate dishes and inspected for flatworms with the aid of a dissecting microscope. Flatworms were studied live under a compound microscope. Fixation of worms for serial sections was in Bouin's fluid. Sections were cut at 5-6  $\mu\text{m}$  and stained with hematoxylin-eosin or Mallory's trichrome stain.

## RESULTS

*Pterastericola rotnnestensis* n.sp.**Type material**

Holotype (SMNH 4841) one longitudinally sectioned specimen from oesophagus of *Astropecten preissi* from sandy bottom off Rottnest Island, Western Australia, January 1991. Paratypes, 8 longitudinally and cross sectioned specimens, from oesophagus and stomach of host, same data as holotype. The worm was present in all five specimens of *A. preissi* dissected. A total of 29 specimens were found. This is the species referred to as *Pterastericola* sp Rottnest by JONDELIUS (1992a; 1992b).

**Description**

Body broad, rounded and flattened anteriorly, tapering posteriorly, unpigmented. Length of live specimens 1.0 mm (0.8 - 1.2 mm, n = 6).

*Pterastericola* with tripartite vitellarium, two anteriorly and one posteriorly directed branches (Figs 1 A, 2 E). Single egg capsule in ootype. Gonopore immediately posterior to pharynx, somewhat left of body midline.

Epidermis uniformly ciliated, cilia about 5  $\mu$ m long. Numerous eosinophilic gland necks penetrate epidermal cells on the ventral anterior surface (Fig. 2A, B). Mouth opening to anterior ventral surface, leading to anteriorly directed sub-spherical pharynx, which is 55 - 60  $\mu$ m long (n = 5), 52 - 60  $\mu$ m wide (n = 4) and 68- 72  $\mu$ m high (n = 3). Brain immediately anterior to pharynx. Intestine sac-like, dorsal, extending posteriorly from pharynx.

Testis a thin-walled sac extending posteriorly from copulatory bulb. copulatory bulb bean shaped 65 - 78  $\mu$ m long and 25 - 38  $\mu$ m wide (n = 5), divided into two compartments holding seminal and prostatic vesicles (Fig. 2 D). Male armature consisting of stylet and accessory piece which is blunt and much shorter than the stylet (Fig. 1 B, C). Muscular male antrum joins ciliated common genital atrium, which reaches ventral body surface at common gonopore.

Single ovary on left side anterior to testis, posterior to gonopore, anteriorly with larger, mature oocytes (Fig. 2 C). Oviduct anteriorly joined first by seminal receptacle and then vitelline ducts and shell glands. No pseudovagina was observed. Egg capsules were only observed in the ootype; none were seen in the parenchyma.

**Comments and differential diagnosis**

Tripartite vitellaria with two anteriorly directed branches occur in *P. sinensis*, Jondelius 1992 a species that, like *P. rotnnestensis*, occurs in the oesophagus and cardiac stomach of an asteroid of the genus *Astropecten*. However, in *P. sinensis* mouth and gonopore are widely separated.

The male armature of *Pterastericola rotnnestensis* differs from other known species of the genus since the accessory piece is much shorter than the stylet, and blunt-ended.

**Etymology**

The species name is derived from the type locality.

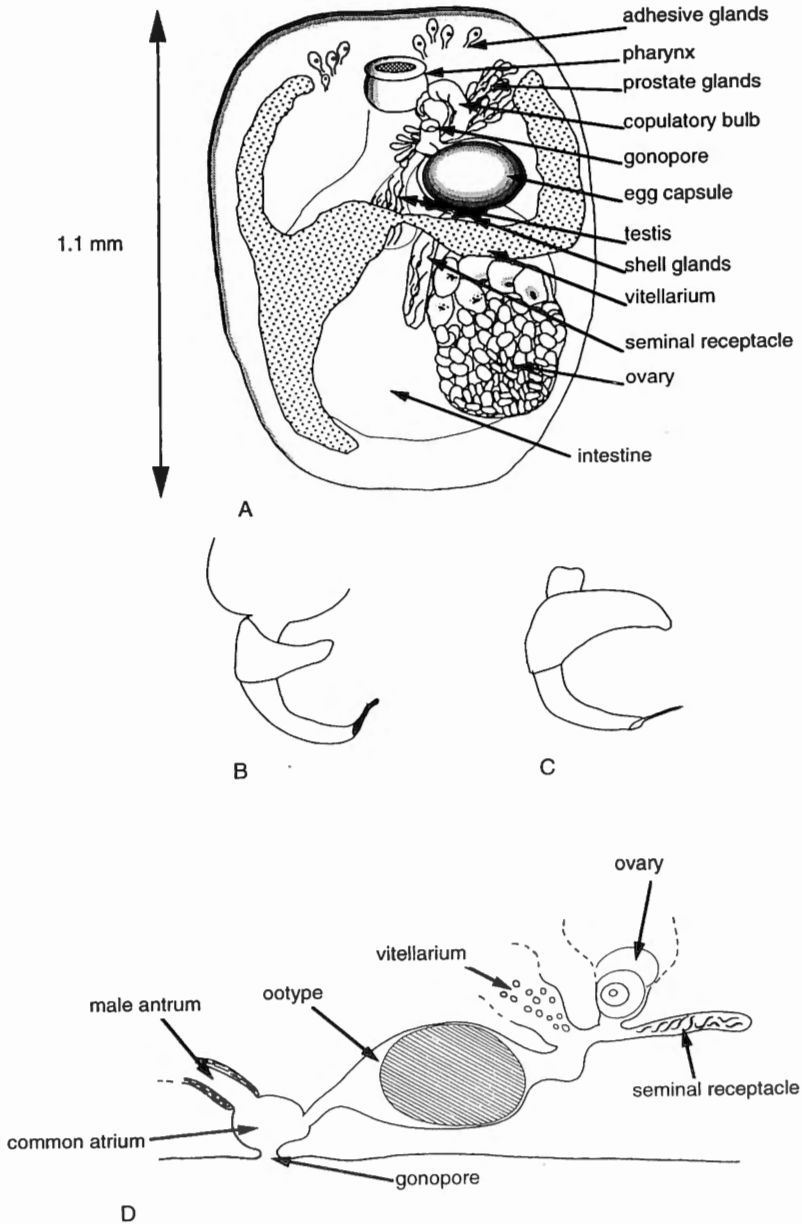


Fig. 1. – *Pterastericola rotnnestensis* n.sp. – A. ventral view of general anatomy; reconstruction from live animals and serial sections – B, C. copulatory stylets drawn from life – D. diagram of genital system in lateral view; reconstruction from serial sections.

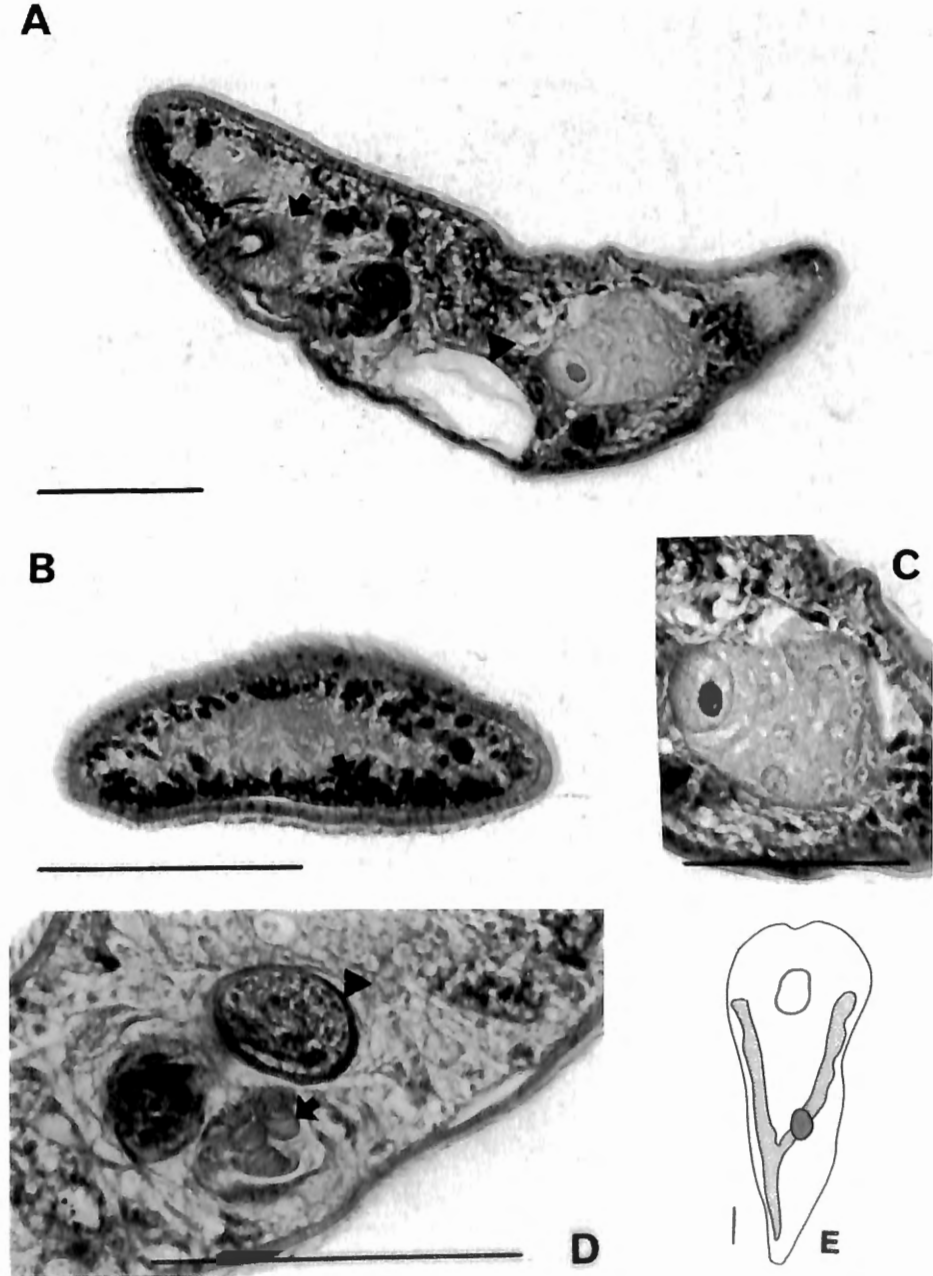


Fig. 2. – *Pterastericola rotnestensis* n.sp. – A. median longitudinal section showing pharynx (arrow), uterus (arrowhead) and ovary – B. cross section of anterior part at the level of the brain showing eosinophilous adhesive glands (arrow) penetrating the ventral epidermis – C. horizontal section of ovary with mature oocytes anterior – D. cross section showing male antrum (arrow), prostate glands and copulatory bulb (arrowhead) – E. free hand drawing of the habitus of live worm. (A-D photomicrographs from serial sections; scale bars: 100  $\mu$ m).

*Syndesmis cannoni* n. sp.**Type material**

Holotype (SMNH 4815) one longitudinally sectioned specimen from intestine of *Ammotrophus arachnoides* from sandy bottom off Rottneest Island, Western Australia, January 1991. Paratypes, 5 serially sectioned specimens, same data as holotype.

The worm was present in all five specimens of *A. arachnoides* dissected with a total of 23 specimens found.

**Description**

Anteriorly and posteriorly blunt-ended, 0.9 - 1.2 mm long (live specimens), red-pigmented *Syndesmis* with short stylet wholly within male antrum. Ejaculatory duct without coils (Figs 3 A, C).

Lateral edges of body curved towards the ventral surface (Fig. 4 C). Dorsal epidermis densely ciliated, cells 7 - 11  $\mu\text{m}$  high, cilia 3-4  $\mu\text{m}$  long. Ventral epidermis 3-4  $\mu\text{m}$  high with sparse, 5-7  $\mu\text{m}$  long cilia. Ventral surface medially with clusters of club-shaped cells that protrude 9-12  $\mu\text{m}$  (n=4) (Figs 4 A, C).

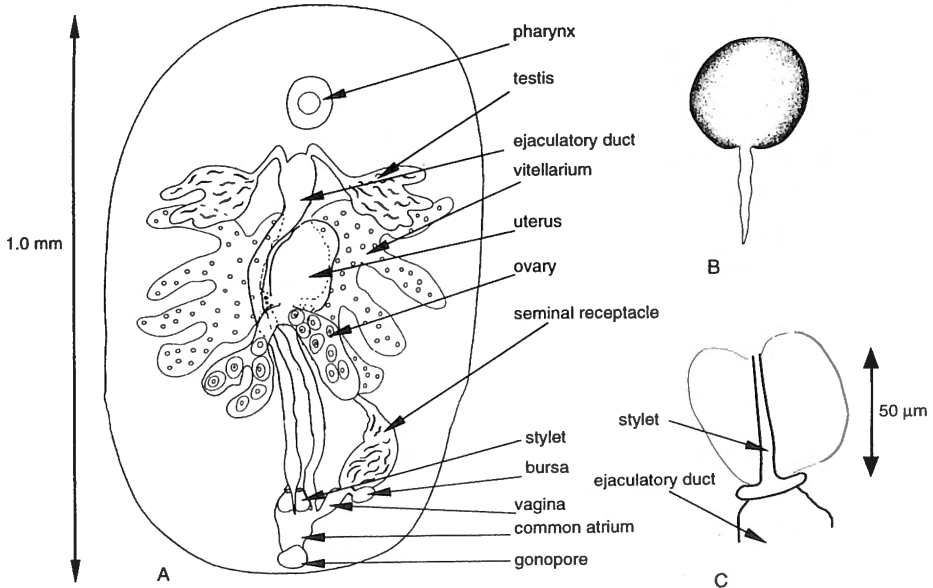


Fig. 3. — *Syndesmis cannoni* n.sp. - A. Dorsal view of general anatomy. Reconstruction from live animals and serial sections.- B. Egg capsule. - C. Camera lucida drawing of stylet surrounded by lobes of pellucid (glandular?) tissue.

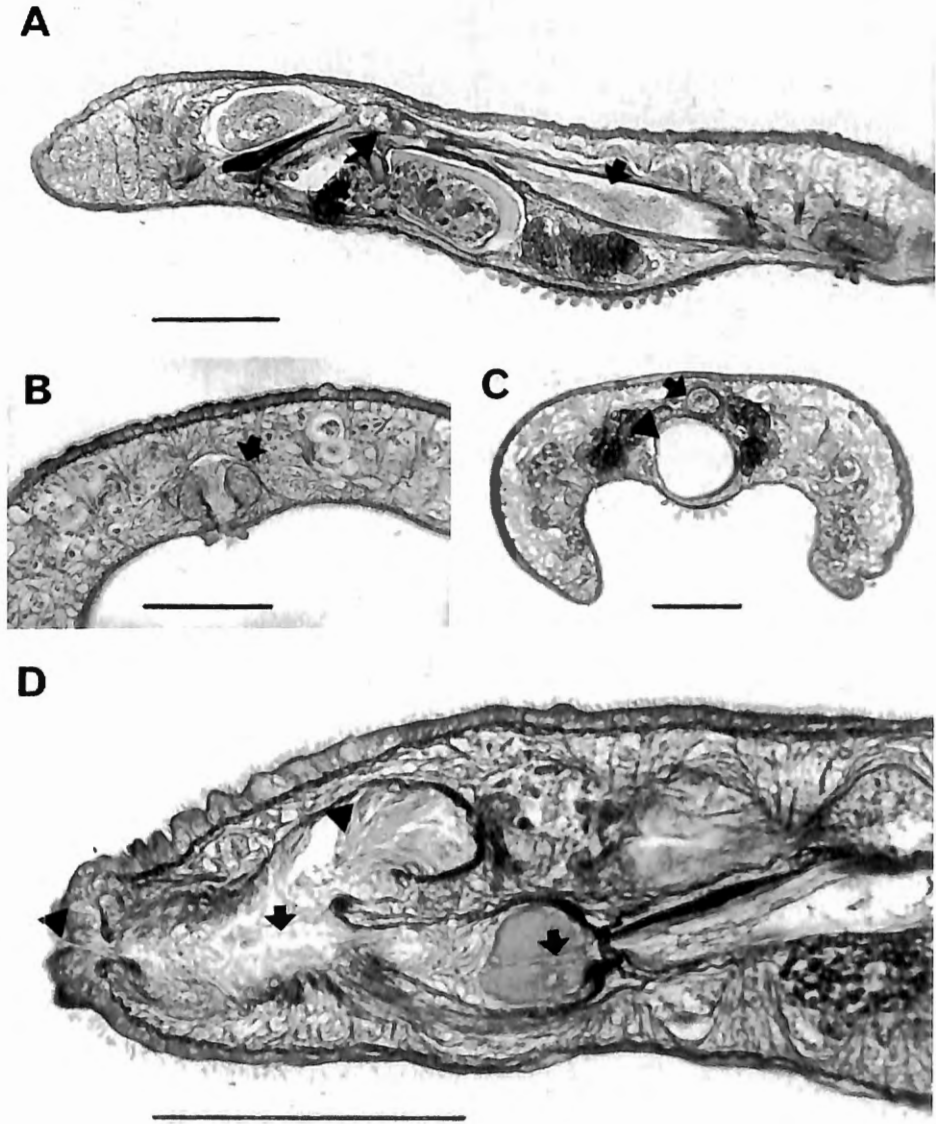


Fig. 4. — *Syndesmis cannoni* n.sp.: photomicrographs from serial sections - A. median longitudinal section showing ejaculatory duct (arrow), uterus (arrowhead) with egg capsule and vitellarium; note papillate epidermal cells ventrally and pharynx anterior to ejaculatory duct - B. cross section showing pharynx (arrow) and dorsoventral musculature - C. cross section showing ejaculatory duct (arrow), uterus (arrowhead) and vitellaria, note curved lateral parts of body and papillate epidermal cells ventrally - D. longitudinal section of posterior part, showing stylet (arrow) connected to walls of male antrum, common atrium (arrow), gonopore and vagina (arrowhead). (Scale bars: 100  $\mu$ m).

Mouth opening to ventral surface one-fifth of the body length from the anterior end. Ventrally directed pharynx, sub-spherical 40-50  $\mu\text{m}$  high, 65-82  $\mu\text{m}$  wide (n=4) (Figs 4 A, B). Saclike, dorsal intestine extending posteriorly from pharynx.

Paired testes on both sides of body midline behind pharynx reach vitellaria posteriorly. Sperm ducts extend anteriorly, turn posteriorly and join common ejaculatory duct. There is no seminal vesicle outside the 600-700  $\mu\text{m}$  long ejaculatory duct, which has no coils, but is sheathed by a 3-5  $\mu\text{m}$  layer of circular muscles. Lumen of ejaculatory duct conspicuous, filled with sperm (Figs 4 A, C, D).

The male antrum has a folded lining (Fig. 4D). Sclerotized straight penis stylet 47-50  $\mu\text{m}$  long (n=4), with proximal collar, positioned in male antrum and attached to the antrum walls through lobes of pellucid (possibly glandular) tissue (Figs 3A and C).

Vitellaria posterior to testes with 4-6 main branches with distal lobes enter uterus/ootype at about half body length. Paired ovaries posterodorsal to vitellaria, each with two lobes. Ovaries enter uterus/ootype posterodorsally to vitellaria. Uterus ventral to ejaculatory duct occupies a large proportion of body cross section when containing an egg capsule (Figs 3AD and 4C). Seminal receptacle enters uterus/ootype posterodorsally, posteriorly tapering to short sclerotized duct entering copulatory bursa. Distally to the bursa a prominent vagina enters the common atrium (Fig. 4 D). Common gonopore postero-terminal.

### Comments and differential diagnosis

The short stylet distinguishes *S. cannoni* from seventeen of the previously described species of *Syndesmis* and *Syndisyrix* (see MOENS *et al.* (1994) for a complete list of species and authors). The remaining species *S. aethopharynx* Westervelt and Kozloff, 1990 has a short stylet, but egg capsules are anterior and the pharynx is club-shaped.

The distinction between the genera *Syndesmis* Silliman and *Syndisyrix* Lehman seems arbitrary. Presence of a bursal valve was regarded by LEHMAN (1946) and CANNON (1982) as the distinguishing feature of *Syndisyrix*. However, KOZLOFF and WESTERVELT (1987) found a bursal valve in *Syndesmis echinorum*, the type species of *Syndesmis*, thus this distinction is not valid. Electron microscopy of the bursal valve in *S. longicanalis* showed it to be a derivative of basal lamina developed to a varying degree in different mature specimens (GEVAERTS *et al.*, 1995). A wide male antrum where the stylet is connected to the walls through tissue is possibly an apomorphy of *Syndesmis* (WESTERVELT and KOZLOFF, 1992), the male antrum being narrower and the stylet free-moving in *Syndisyrix*. However, data on these features are lacking for many of the *Syndesmis* /*Syndisyrix* species. Classification must depend on hypotheses of phylogeny, and such are not available at present for the species of the *Syndesmis* - *Syndisyrix* complex, hence there is no reason to split them into separate genera. I thus concur with MARCUS (1949), WESTBLAD (1953), HYMAN (1960) and MOENS *et al.* (1994) that *Syndisyrix* should be suppressed and all the species referred to *Syndesmis*.

### Etymologie

The species is named after Lester R. G. Cannon in recognition of his contribution to the knowledge of symbiotic flatworms.

*Wahlia westbladi* n. sp.**Type material**

Holotype (SMNH 4816) one longitudinally sectioned specimen from papillose anterior part of intestine in *Stichopus mollis* from bottom off Rottneest Island, Western Australia, January 1991. Paratypes, one longitudinally sectioned and one cross sectioned specimen, same data as holotype. Several specimens studied live. A total of 23 specimens were found in the four specimens of *S. mollis* dissected.

**Description**

Red-pigmented, with broad anterior end, tapering posterior. Body length 1.7 mm (1 - 2.5 mm, n = 6), relaxed specimens longer than 2 mm. Pharynx one-sixth body length from anterior. Anterior end of worms often positioned between papillae of host intestine with posterior protruding upwards from the epithelium.

One dorsal and two lateral longitudinal ciliated bands present, remainder of epidermis unciliated. Mouth opening large, about 75  $\mu\text{m}$  wide, to ventral surface. Pharynx ventrally directed, thin-walled but wide 150-200  $\mu\text{m}$  (anterior- posterior) by 150-160  $\mu\text{m}$  (lateral) (n=3). Intestine a simple sac wholly posterior to pharynx, lined with vacuolated cells (Fig. 6A).

Paired lateral testes without prominent lobes from level of pharynx posterior to about two-thirds of body length (depending on stage of maturity). Sperm ducts from posterior part of testes extend anteriorly and unite to form common sperm duct before entering seminal vesicle positioned anterior to pharynx. Seminal vesicle curved, proximally bulbous 50  $\mu\text{m}$  by 60  $\mu\text{m}$  in longitudinal section on holotype. Long sclerotized copulatory stylet runs through body near midline, enters bulbous penis papilla with muscle fibres and vacuolate tissue (85 x 95  $\mu\text{m}$  in longitudinal section of paratype), and makes a 360° loop. Common genital pore postero-terminal (Figs 5 A, C, 6 B, C, D).

Paired ovaries unbranched but with distal lobes, curving posteriorly from ootype. Vitellaria lateral, two main branches on each side of the body extend anteriorly from ootype to level of pharynx with numerous small lateral branches. Vagina dorsal from common atrium joining seminal receptacle (Figs 5 A, C, 6 D) through a short and narrow sclerotized tube (Fig. 5 C). Seminal receptacle dorsal, with sperm-filled vacuoles (Fig. 6D) connected to ootype through unsclerotized duct with sphincter. Bursal valve absent. Distally the primary uterus (about 200  $\mu\text{m}$  long), which contains one untanned egg capsule in mature specimens, joins the secondary uterus (about 180  $\mu\text{m}$  long in sectioned paratype), which normally contains two tanned egg capsules.



The tetrahedral tanned egg capsules are often released when live worms are transferred from the host intestine to a glass dish. Tail piece of egg capsules distally split into multiple coiled threads (Fig. 5B).

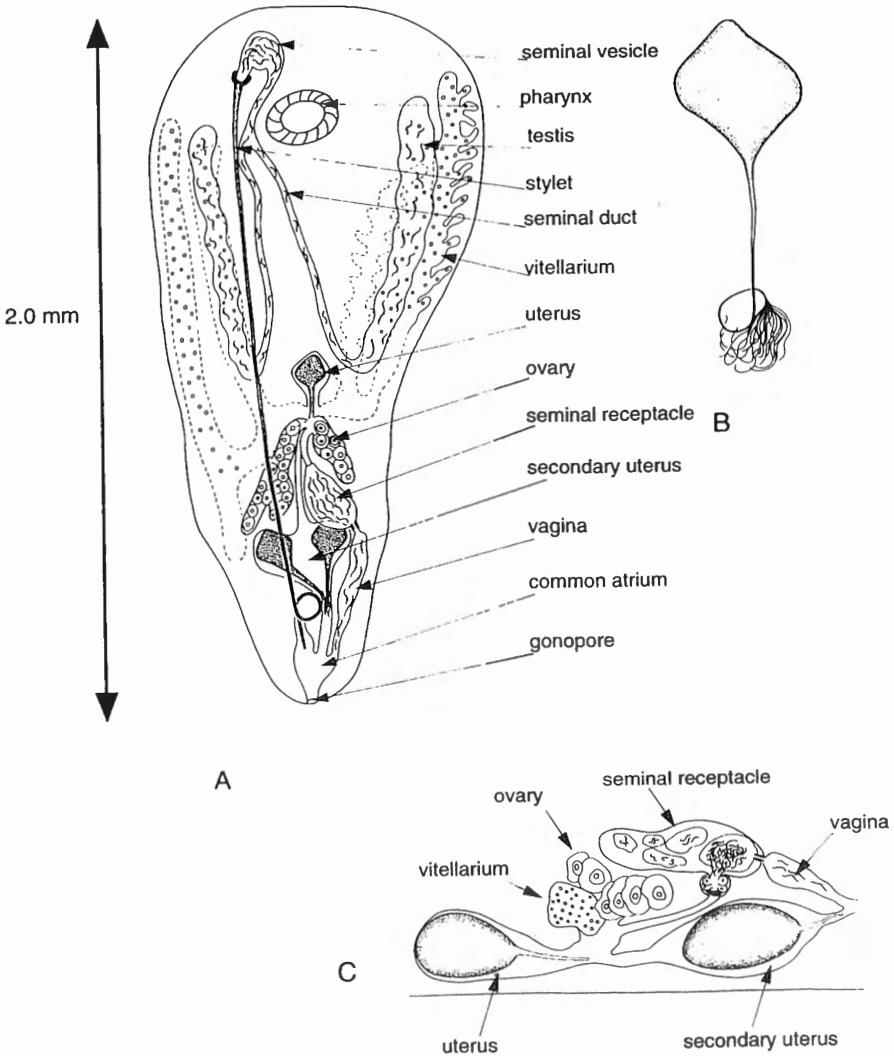


Fig. 5. – *Wahlia westbladi* n.sp. – A. dorsal view of general anatomy; reconstruction from live animals and serial sections – B. egg capsule – C. organisation of female system in lateral view.

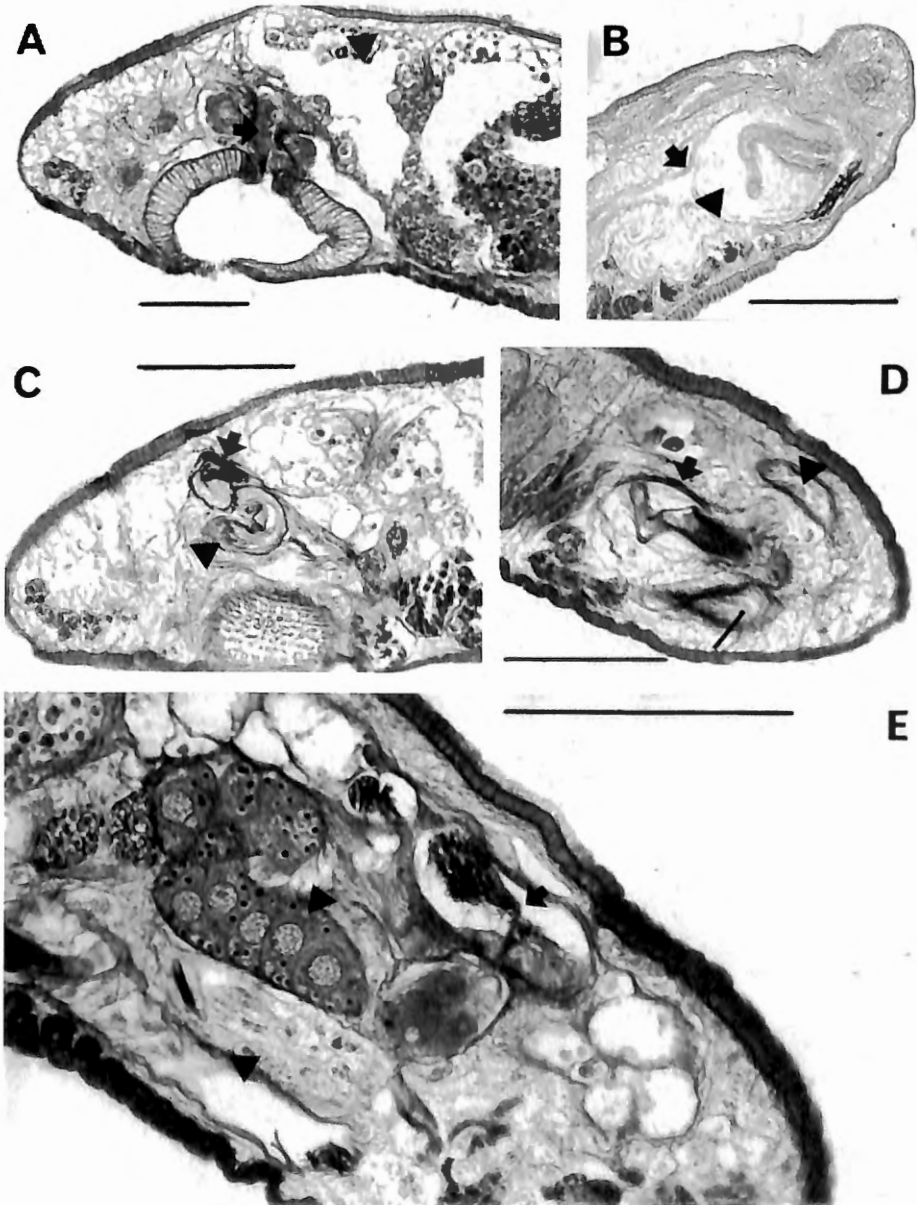


Fig. 6. – *Wahlia westbladi* n.sp.: photomicrographs from serial sections – A. longitudinal section through pharynx, oesophagus (arrow) and intestine – B. longitudinal section showing stylet (arrow) entering loop tissue (arrow head) – C. longitudinal section showing tangentially sectioned pharynx, seminal vesicle (arrowhead) and proximal part of stylet (arrow) – D. longitudinal section showing stylet in loop tissue (arrow), vagina (arrowhead) and distal part of uterus (line) – E. longitudinal section showing seminal receptacle (arrow), ovary (arrowhead) and uterus (arrowhead); note ciliated dorsal part of epidermis. (Scale bars: 100  $\mu$ m).

### Comments and differential diagnosis

The copulatory stylet in *Wahlia westbladi* is longer relative to the length of the body than the stylets of *Seritia striata* (Hickman, 1955), *W. arbora* (Ozaki, 1932), *S. elegans* (Westblad, 1953) and *W. pulchella*, Kozloff and Shinn, 1987. In *W. arbora* the testes are lobulate and vitellaria reach posteriorly to the level of the common atrium. In *W. elegans* the pharynx is antero-terminal.

The species that most closely resembles *W. westbladi* is *W. macrostylifera* Westblad, 1930 from the intestine of *Parastichopus tremulus* (Gunnérus, 1767) on the Norwegian west coast. *W. macrostylifera* and *W. westbladi* have similar body to stylet length ratios. However, *W. macrostylifera* possesses H shaped vitellaria. Examination of Westblad's material (SMNH) reveals the uterus wall to be more muscular, and the proximal, sclerotized part of the vagina is longer than in *W. westbladi*. Furthermore, WESTBLAD (1930) reports the body length of fully extended specimens to 1.5-1.6 mm whereas *W. westbladi* reaches 2.5 mm.

The nature of the bursa copulatrix, the bursal valve and the seminal receptacle in *Wahlia* and related genera was discussed by CANNON (1982) and KOZLOFF and SHINN (1987). The latter authors concluded that a seminal bursa is absent in the genus *Wahlia* (also including the species previously referred to *Ozametra*) and referred species with a distinct bursa to the genus *Seritia* Cannon. Unfortunately they provided no micrographs to illustrate the differences in the female systems of the two genera. Perhaps the situation in *Wahlia westbladi* could be regarded as intermediate: a discrete bursa with sclerotized excurrent nozzle and sheath is absent, but there is a sclerotized proximal part of the vagina opening into the seminal receptacle and a sphincter surrounding the proximal parts of the seminal receptacle.

### Etymology

The species is named in recognition of Einar Westblad for his contribution to platyhelminth research.

### ACKNOWLEDGEMENTS

Dr. Fred Wells and co-workers are thanked for inviting me to the Marine Biological Workshop on Rottne Island. Anna Hedström and Barbro Löfnertz prepared serial sections and whole mounts. Christine Hammar finished the drawings. Financial support was received from the Swedish Natural Science Research Council (NFR) and the Lars Hiertas Minne Foundation.

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